

Concept for Radiation Detection Using Distributed Sensor Networks with Collective Computation

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Abstract

DSN-CC capabilities provide the technical underpinnings to address national security missions. Applications include situational awareness, monitoring, or defense of critical facilities or geographic regions (homeland defense and proliferation detection). Sensor suites depend on the application but may include anything from miniaturized *in-situ* sensors to remote sensors on robots, UAVs, aircraft, or satellites. Many signatures can be detected only by placing sensors in close proximity to the target. These include vibrations in the earth, short-range radio and acoustic signals, production facility effluents, spores from biological weapons, and radiation from nuclear material. DSN-CCs are pertinent to radiation detection situational awareness for the following applications: the protection of critical facilities, cities, or regions; the search and diagnostic of nuclear material in wide area radiation surveys; the response to nuclear accidents or terrorist acts requiring monitoring for dispersal of radioactivity; safeguards for the protection of nuclear material in storage; and finally remote sensing addressing space exploration and planetary science questions. The physical signatures of interest for nuclear material are known. The difficulty of the problem varies depending on the specific radiation detection application. Each application has specific problem requirements and boundary conditions that significantly impact the complexity of the problem. For example, the requirements for detection may vary with respect to the intensity and mobility of the signatures, the topography, population density, and proximity of physical structures in the detection area, and the number of dispersal or transit pathways. There are two primary radiation detection challenges that must be addressed. Nuclear sensors have short ranges since the signals are small and the backgrounds are large. The solution to these challenges is to either reject the large background signal by imaging or to bring the detector to the source. Bringing the sensor closer to the source via DSN-CC is the concept proposed. This is achieved by utilizing a hybrid DSN-CC that employs both statically placed and mobile detectors over a large area (application dependent).